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GROWING ONION TRANSPLANTS IN PLUG TRAYS

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INTRODUCTION

Greenhouse-grown containerized transplants are becoming increasingly popular as a way to establish vegetable crops. In Ontario, cooking onions have been grown from transplants for almost a decade. Approximately 80 ha (200 acres) of onions are grown from transplants each year in the Holland Marsh area. The process of producing transplants and planting them in the field has become more efficient with the use of plug trays. This allows transplants to grow in individual cells, which reduces competition among plants and improves uniformity. Transplant shock is also reduced because there is minimal disturbance to the roots during transplanting.

The type, depth and size of the tray used influences field performance of the transplants. A deeper-celled tray has a larger cell volume so more water and fertilizer are available to the plant. Plastic plug trays are available in various sizes (Table 1) and are more common, since Styrofoam transplant trays are more expensive, promote algae and harbour disease. By growing their own transplants, growers reduce crop loss from insects, nematodes and soil-borne diseases such as damping-off and smut. Temperature, relative humidity and soil moisture can be controlled in the greenhouse (Figure 1) to reduce the risk of damping-off, and transplants have a greater chance of survival against this pathogen in the field.

By choosing transplants over direct seeding, growers also avoid crop loss due to onion smut infection. Because smut can infect onions only during the first few weeks after germination, and transplants are grown in a disease-free medium, the plants are immune to smut by the time they are set out in the field.

There are several other advantages to using transplants. Earlier harvest is more attainable with transplants than a direct seeded crop. Transplanted onion crops usually mature at least 5–10 days earlier than seeded onion crops (Figure 2). Generally, an early crop can be sold for a higher price. Growing transplants conserves seed, produces a higher germination rate, and more uniform, large and high quality plants (Figure 3).

Growers can produce suitable transplants that are ready when needed and can avoid weather conditions early in the spring that can preclude field seeding. The plants can be held in relatively good condition even if inclement weather delays field transplanting. The possibility of importing foreign weeds and diseases is eliminated since growers can exercise control over seed sources, the type of growing medium and pest management.

TABLE 1. Specifications of common plastic seed trays used for onion transplants

Number of Cells per tray	Cell Diameter (top)	Cell Depth	Cell Volume ¹ (cm ³)	Drainage Hole Diameter
128	1 1/4"	2"	23-28	3/8"
200	7/8"	1 3/4"	11-13	9/32"
288	3/4"	1"	7	5/16"
288 medium	13/16"	1 1/4"	10.5	5/16"
288 deep	3/4"	1 3/4"	10	5/16"

¹ Cell volume (cubic centimetres) varies depending on the depth and shape of the cell.

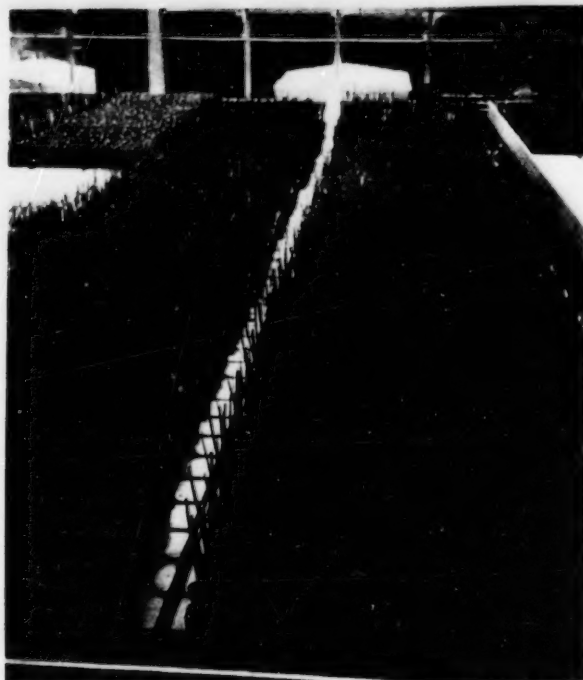


FIGURE 1. Onions growing in plastic plug trays, on raised benches in the greenhouse.



FIGURE 2. Mature transplanted onions.



FIGURE 3. Transplanted onions growing in the field.

SEEDING TRAYS

Traditionally, the growing media or soilless mix is comprised of a combination of peat, perlite and vermiculite.

Take care to choose a growth medium free of contamination. Currently, the most popular soilless mixes are Pro Mix BX and ASB. Some soilless mixes contain fertilizer, which must be considered when mixing and applying fertilizers (Table 2). Artificial mixes are popular because they are sterile, easy to handle and provide uniform, rapid growth.

Seeding usually begins in early to late March. Yellow and red onions are most commonly direct-seeded, 3-5 seeds per cell, into 288 plastic or 338 Styrofoam plug trays. Spanish varieties are usually seeded 1-2 seeds per cell.

Growing onions from transplants is very labour intensive. For this reason, growers usually produce enough transplants to grow 3.2-8 ha (8-20 acres). Early varieties, with the shortest maturity time, such as Norstar or Corona are most suitable.

Trays are filled with pre-moistened growing media, compressed approximately 6 mm to make a uniform surface for the seed. If the seed are too shallow, the onions will tend to push themselves up out of the plug. The seeded trays are then covered with medium-grade vermiculite. Vermiculite is preferred because it can be applied evenly, allows good aeration, and does not support algae growth. Seeded trays are usually placed in the greenhouse on elevated benches to prevent root growth through the bottom (Figure 4).

TABLE 2. Chemical analyses of samples of selected plug media*

GROWING MEDIA	pH	Nitrate(ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
Pro Mix BX	5.6	115	35	117	145	44
ASB	5.5	67	30	91	32	42
Metro Mix 200	6.5	50	5	99	144	84
Metro Mix 240	6.2	39	6	68	99	77
Speedel	6.3	89	4	62	145	62

Media vary in nutrient concentration, so fertility and watering practices must be adjusted.



FIGURE 4. Onion transplants in Styrofoam plug trays, on raised benches, in the greenhouse.

CROP REQUIREMENTS

The optimum temperature for onion germination is 18°C–24°C. Seedlings usually begin to emerge after 3–5 days and do best at growth temperatures of 16°C–18°C during the day and 8°C–15°C at night. The Different Method (DIF) is a method of managing greenhouse day/night temperatures to control plant height. The DIF is determined by subtracting the nighttime from the daytime temperature.

A high day temperature gives a positive DIF and promotes growth while a lower day temperature gives a negative DIF, which retards growth. Usually 4°C–5°C negative DIF will give good height control. High temperatures during the first 3–4 hours after sunrise can cause considerable stretching. This stretching can be reduced by keeping the greenhouse temperature cooler during the morning hours compared to the nighttime temperature.

Prior to the growing season, conduct a detailed water analysis. The greenhouse fertilizer program may have to be adjusted according to the pH, bicarbonate level and nutrient content of the water supply.

The water used to irrigate transplants should have a pH of 5.5–6.5 and should be low in soluble salts as high levels of salt can damage seedlings. Bicarbonate levels provide a measure of water "hardness" and indicate the amount of acid required to adjust the pH. A water sample containing 90 ppm bicarbonate is considered soft, while 350 ppm is considered hard. The bicarbonate level of the irrigation water is best in the 60–100 ppm range in order to avoid big changes in pH when adding certain types of fertilizers. Every 60 ppm of bicarbonate to be neutralized requires 7 L of phosphoric acid (85%) per 100,000 L of water or 7 L of nitric acid (67%). Nitric acid is the most common choice for neutralizing more than 60 ppm bicarbonate. Each 7 L of nitric acid will contribute 14 ppm of nitrate nitrogen to the irrigation water.

The amount and frequency of watering varies depending on the type of trays used, the growth media, greenhouse ventilation and weather conditions. Water plug trays thoroughly in the morning, and do not water late in the afternoon, since disease problems increase when plants remain wet overnight. Fertigation, or the use of water-soluble fertilizers at the time of each watering, is one method of feeding young transplants. Several of the fertilizer analyses recommended for transplant production are listed in Table 3. These materials may vary in percent nitrogen (N), phosphate (P_2O_5), and potash (K_2O); and in micronutrients. Greenhouse grade ammonium nitrate, potassium nitrate, and calcium nitrate should be the primary nutrient sources.

TABLE 3. Concentrations of N, P, and K for 100 ppm solutions of various soluble fertilizer materials that are suitable for use in vegetable transplant production

Fertilizer analysis	Rate of 100 ppm N (g/100 l/h ₂ O)	N (ppm)	P (ppm)	K (ppm)
20-20-20	50	100	43	83
20-10-20	50	100	21	83
20-8-20	50	100	17	83
15-5-15	67	100	14	83
14-0-14	71	100	0	83

The usual concentration of N applied is 100–200 ppm every 4–6 days, depending on weather conditions. Plants use more water and nutrients under optimal growing conditions. If conditions are cool and cloudy fertilize transplants less frequently. The general rule is the more often the plants are fertigated, the lower the required nutrient concentration for any given fertigation.

Excessive use of fertilizer can result in high levels of soluble salt in the media. High concentrations of soluble salts can severely restrict plant growth. Soluble salts can also interfere with the uptake of water by the plants. Applying large amounts of water will help reduce the concentration of soluble salt in the plug media.

The optimum age for vegetable transplants depends on both the crop and the cell size used. In general, larger cells enable production of a larger, more mature transplant. Onion transplants are usually clipped to 8–12 cm height several times to produce sturdy plants and are usually transplanted out at the 8–10 week-old stage. Plants should be "hardened-off" or acclimated to the shock and stress of transplanting by slowly removing the optimum growing conditions of the greenhouse which is accomplished by reducing the water, temperature and fertilizer given to the plants.

Transplants are often moved outside, onto wagons, 2 weeks before transplanting to help harden the plants (Figures 5 & 6). Once outside, Lorsban 4E can be applied to prevent damage from onion maggot in the field. This insecticide is usually applied 3–5 days before transplanting at 1.6 mL product in 500 mL of water per tray.



FIGURE 5. Hardening-off transplants outside on wagons.



FIGURE 6. Onion transplants in Styrofoam plug trays, prior to field transplanting.

Yellow and red onions are usually transplanted in 4 rows, approximately 40 cm apart with 10–15 cm (yellow) or 15–20 cm (red) between plugs (Figure 7). Spanish varieties are also transplanted in 4 rows approximately 43 cm apart with 12 cm between plugs.



FIGURE 7. Mechanical transplanter used to transplant onion seedlings in the field

DISEASE PREVENTION

The best strategy to prevent disease on transplants is by using clean seed, proper sanitation and by managing the greenhouse environment to suppress disease development.

Sanitation

Control weeds inside and outside greenhouses that may harbour disease when reusing trays: wash and remove any soil or media, rinse washed trays in D.C.D. or Virkon disinfectant (according to the manufacturer's recommended concentration) or 1% chlorine bleach solution (rinse trays thoroughly as chlorine can be toxic to young seedlings).

Damping-off Control

Ventilation, which provides air movement, is the best method of preventing most damping-off and foliar fungal diseases. If signs of damping-off are present refer to OMAFRA Publication 371, *Growing Greenhouse Vegetables*.

Chemical controls

Very few fungicides are registered for onion transplants in the greenhouse. Consult OMAFRA Publication 363, *Vegetable Production Recommendations*

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